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16. Abstract (MAXIMUM 200 WORDS)

The overall objective of this evaluation was to further develop an understanding of the capabilities and limitations of water mist systems as applied to machinery space applications. The primary objective of this investigation was to evaluate the applicability of a local application test method being considered by the International Maritime Organization (IMO). An evaluation of the effects of mist spray obstructions on extinguishment capabilities was performed. The effects of compartment parameters (size and vent area), mist system parameters (system flow rate), and fire parameters (heat release rate, fire type, location, and degree of obstruction) were evaluated to aid in validating a scalability model. This model can be used to scale test results to other sized compartments.

Local application water mist systems are capable of extinguishing spray and pan fires if they produce sufficient mist concentrations uniformly around the protected object. They do have limited capabilities against obstructed fires. The size of the obstruction and separation distance between the obstruction and the fire were identified as primary variables. A steady state model was validated that predicts compartment temperatures, oxygen concentrations, and critical fire sizes.

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EXECUTIVE SUMMARY

An investigation was conducted to further develop an understanding of the capabilities and limitations of water mist systems as they apply to machinery space applications. The primary objective of the investigation was to evaluate the applicability of a local application test method currently being considered by the International Maritime Organization (IMO). In addition, the effects of compartment parameters (size and vent area), mist system parameters (mist system flow rate), and fire parameters (heat release rate, fire type, location, and degree of obstruction) were also evaluated.

The U.S. Coast Guard's Research and Development Center has been actively involved in the research effort to identify alternative fire suppression methods and/or agents for Halon 1301 total flooding systems. The research, to date, has focused on both the gaseous halon alternatives and water mist technologies. The International Maritime Organization currently allows the protection of machinery spaces with total flooding water mist systems. The IMO is currently considering the use of water mist as a local application system to be used in conjunction with a total compartment protection system. These recent developments are of interest to the Coast Guard for two reasons: (1) to provide protection of the machinery spaces for their new classes of cutters, and (2) to provide data for U.S. regulatory acceptance of water mist technologies.

In September 1996, the Fire Protection Sub-Committee of the IMO Maritime Safety Committee discussed the use of water mist as a local application system to be used in conjunction with a total compartment (flooding) protection system. The use of water mist as a local application system is relatively untested outside of a limited number of tests conducted by the Japanese and the applications described in NFPA 15 [7]. The test series described in this report was initiated to address many of these unresolved issues associated with the use of water mist, as both a total flooding system and a local application system in machinery space applications.

Over one hundred and fifty full-scale fire suppression tests were conducted during this investigation. The tests were conducted in a simulated machinery space aboard the test vessel, STATE OF MAINE, at the U.S. Coast Guard Fire and Safety Test Detachment located at Little Sand Island in Mobile, AL. The compartment was constructed to meet the dimensional (500 m^3) requirements of the IMO test protocols for evaluating total flooding systems. Four generic water mist systems produced using off-the-shelf industrial spray nozzles and one UL listed NFPA-15 water spray system were included in this evaluation. The information collected during this test series supports the following conclusions:

- Local application water mist systems are capable of extinguishing a variety of heptane or diesel spray and pool fires if the nozzles are installed above the hazard and the system is designed to produce a sufficient mist concentration uniformly around the object being protected. Local application water mist systems have limited capabilities against obstructed fires, requiring additional measures for obstructed areas. When a system was not capable of extinguishing the fire, the thermal conditions produced by the fire were significantly reduced (30-70% reduction). The results of these tests also aided in the further development of a test protocol for evaluating local application water mist systems.
- The ability of total flooding water mist systems to extinguish small fires is related to the degree of obstruction of the fire. The size of an obstruction and the distance between an obstruction and the fire were identified as the primary variables associated with the effectiveness in the extinguishment of these fires. As the size of the obstruction was increased or the distance between the fire and the obstruction was decreased, the extinguishment times increased.
- A steady state model developed during the initial phase of this investigation was validated for a range of fire sizes, ventilation conditions, and water mist flow rates. The model was able to accurately predict the steady state compartment temperatures, oxygen concentrations, and critical fire size for the tests conducted during this investigation. The model has served as the foundation for the development of a transient model.